FLORENCE COPPER

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U.S. Environmental Protection Agency
Region IX (STR-4-2)
75 Hawthorne Street
San Francisco, California 94105

Attention: Nancy Rumrill, Water Division

C: Maribeth Greenslade, Arizona Department of Environmental Quality

Subject: Technical Review Comments on the June 12, 2020 Responses for Florence Copper UIC Class III Permit Application

Dear Ms. Rumrill:

Florence Copper Inc. (Florence Copper) is submitting the following in response to the letter request for additional information by the U.S. Environmental Protection Agency (USEPA) received via email on July 25, 2020. In the letter, USEPA requested additional information to clarify, modify, or supplement materials submitted with the Underground Injection Control (UIC) Permit Application No. R9UIC-AZ3-FY19-1 transmitted to the USEPA on October 4, 2019 (Application) and supplemental materials submitted on June 12, 2020. Florence Copper's responses to each request are provided below under numbered headings that correspond to the USEPA's request letter enclosure.

Attachment C of the application has been revised to reflect the responses to comments described below. Each of the responses provided below details where changes have been made to the Application. The revised Attachment is provided with this comment response document. Please replace Attachment C in your files with the revised version provided herewith.

Technical Review Comments

Comment 1:

Florence Copper proposes to install Annular Conductivity Devices (ACDs) in In-Situ Copper Recovery (ISCR) wells at a point 10 feet below the Middle Fine Grain Unit (MFGU), or no more than 190 feet above the bedrock/Lower Basin Fill Unit (LBFU) contact, where the contact is separated from the LBFU by more than 200 feet. In our letter dated May 15, 2020, EPA requested that ACDs be placed above and below the LBFU/MFGU contact and closer than 200 feet from the top of bedrock where separated from the MFGU by more than 200 feet. Section C.2.5 of the permit application states that an ACD will be

installed on FRP or PVC well casing of all injection, recovery, observation, and perimeter wells in a location that is no higher than 10 feet below the MFGU or no more than 190 feet above the top of bedrock where bedrock is separated from the MFGU by more than 200 feet. The proposed ACD locations have been revised as described above, but only in ISCR wells.

Please clarify or correct the response accordingly. An ACD should also be installed above but within 10 feet of the MFGU/UBFU contact in addition to the lower ACD installed below the MFGU. Please provide the additional ACD locations above the MFGU/UBFU contact in the UIC Permit application.

Response to Comment 1:

In the June 12 response document, Florence Copper proposed to install the ACDs in a lower position below the MFGU in response to the USEPA comment because the purpose of the ACDs is to detect vertical movement of injected fluid. Placing the ACD below the MFGU will have the effect of signaling upward migration of injected fluid prior to the fluid reaching the overlying underground source of drinking water (USDW). This would obviate the need for ACDs within the USDW because any fluid moving upward would be detected and contingency actions triggered before the upper ACD detected fluid migration.

In response to this comment, Florence Copper proposes to install two ACDs on each well at the limits of the exempted aquifer. One ACD will be installed at a point 10 feet below the MFGU, and a second ACD will be installed no more than 10 feet above the MFGU. In areas where the MFGU lies more than 200 feet above the bedrock/LBFU contact, an ACD will be installed no more than 190 feet above the bedrock/LBFU contact, and a second ACD will be installed no more than 210 feet above the bedrock/ LBFU contact.

This placement of the ACDs above and below the limit of the exempted aquifer will provide an indication of solution migration prior to reaching the vertical limit of the Aquifer Exemption before a hypothetical solution excursion would reach the USDW, and after a hypothetical excursion into the USDW. The ACDs will be installed at this level on every ISCR well within the commercial wellfield.

During wellfield development, ISCR wells installed in the interior of the wellfield will serve as perimeter and observation wells until such time as the wellfield expands to include those wells for injection and recovery uses. Consequently, the only perimeter and observation wells that will not be later used for injection and recovery of fluids are those located at the edge of the maximum wellfield footprint. Although these perimeter wells and observation wells will not be used for injection and recovery of solutions, each of these wells will have ACDs installed at the limits of the exempted aquifer, as described above.

Figures C-1 and C-2 have been revised to show typical ACD installation above and below the MFGU and are provided herewith.

Comment 2:

In FCI's response dated June 12, 2020, FCI proposes to install ACDs at a depth of 20 feet above the bedrock/LBFU contact in 10 percent of the ISCR wells to provide a dataset that will support statistical analysis of monitoring results and early warning of potential vertical solution migration.

For clarification, please provide an illustration of a typical ACD installation in a well that penetrates a fault plane.

Response to Comment 2:

In the June 12 response document, Florence Copper proposed to install early warning ACDs in each resource block as follows:

1. Where mapped faults transect a resource block, two ACDs will be installed on wells that are projected to penetrate the fault plane. The additional four ACDs will be installed at locations distributed across the resource at approximate even spacing.
2. Where mapped faults transect a corner or small portion of a resource block, a minimum of one ACD will be installed on a well that is projected to penetrate the fault plane. The remaining ACDs will be installed at locations distributed across the resource at approximate even spacing.
3. In partial resource blocks located at the edge of the Production Test Facility (PTF) wellfield, an early warning ACD will be installed on at least one well if fewer than 10 wells are planned for the resource block, or will be installed on 10 percent of the wells in the block if more than 10 wells are planned for the resource block. ACDs installed in partial resource blocks at the edge of the wellfield will be installed in areas where mapped faults are projected or will be approximately evenly distributed across the resource block if no mapped faults transect the resource block.

An illustration showing the typical ACD installation at an ISCR well that penetrates a fault plane is shown on Figure C-4a.

Figure C-3 has been revised to show the installation of an early warning ACD as proposed on 10 percent of ISCR wells, and ISCR wells that penetrate projected fault planes. The revised Figures are provided herewith.

Comment 3:

In FCI's response dated June 12, 2020, FCI proposes to install four monitoring wells at the bedrock/LBFU contact at locations where mapped faults transect the AOR, between the edge of the ISCR wellfield and the AOR boundary, as depicted in Figure A-17. "These wells will serve to monitor for potential fluid migration through faults into the LBFU at the edge of the ISCR wellfield."

Please explain FCI's rationale for proposing only four monitoring wells and why FCI is not proposing additional monitoring wells overlying the orebody in the interior of the ISCR wellfield.

Response to Comment 3:

As shown on Figure A-17, provided with the June 12, 2020 response, two major faults have been mapped and projected to transect the ISCR wellfield. The four proposed monitoring wells are located at the edge of the ISCR wellfield where the faults transect the edge of the wellfield. Because two faults are projected through the wellfield, four transection points occur where the faults cross the wellfield boundaries. One

monitoring well is proposed at each transection point, where the fault also intersects the top of bedrock. The purpose of these wells is to monitor for fluid migration along the fault plane and into the LBFU.

No monitoring wells are proposed within the ISCR wellfield area for the following reasons:

1. Florence Copper has proposed to monitor for vertical fluid migration within the ISCR wellfield area using the modified ACDs described in Attachment C of the October 4, 2019 UIC Application. The ACD includes conductive, acid resistant arms that will contact the formation at the borehole wall, facilitating detection of vertical migration of injected fluid. In the June 12, 2020 response, Florence Copper proposed to install additional early warning ACDs in areas where ISCR wells are expected to intersect mapped faults. The monitoring precludes the need for additional monitoring wells at this location. The ACD design is shown on Figure C-4 of the October 2019 UIC Application and is attached hereto for the reviewer's convenience.
2. The ISCR wellfield will be a hydraulically active area with carefully balanced injection and recovery ongoing at wells spaced 50 feet and 71 feet apart in two dimensions. The addition of monitoring wells in this congested wellfield area, located closely above the injection area, has the potential to induce vertical migration as pumping is conducted to withdraw samples. This monitoring has the potential to induce migration and produce false-positive results.

Comment 4:

"FCI also proposes to install six monitoring wells at the western edge of the ISCR wellfield where a thin section of the non-exempted LBFU overlies the orebody." Three of the wells will be constructed with the well screens placed in the center of the 200-foot thick exempted aquifer area, between the orebody and the non-exempted LBFU. Three other wells will be constructed adjacent to the LBFU wells but will be screened at the bottom of the UBFU, above the exempted aquifer. "These monitoring wells will provide early warning of lateral and vertical migration of injected fluids toward non-exempted LBFU which overlies the orebody, and the UBFU."

Please justify those locations and explain why only six monitoring wells are proposed. Specifically, explain why additional monitoring wells are not proposed overlying the orebody in the interior of the ISCR wellfield and at the southern, northern and eastern perimeter of the wellfield.

Response to Comment 4:

Florence Copper has proposed the installation of six monitoring wells at the edge of the ISCR wellfield to monitor areas where a section of non-exempted LBFU overlies the orebody at the spacing shown on Figure A-17 for the following reasons:

1. The proposed additional monitoring wells are spaced at intervals similar to the existing Point of Compliance (POC) wells on the western edge of the ISCR wellfield. Similar to the POC well spacing, this well spacing is sufficient to detect fluid migration along representative flow paths within the LBFU and Upper Basin Fill Unit (UBFU).
2. Florence Copper has proposed to monitor for vertical fluid migration within the ISCR wellfield area using the modified ACDs described in Attachment C of the October 4, 2019 UIC Application. The ACD includes conductive, acid resistant arms that will contact the formation at the borehole wall, facilitating detection of vertical migration of injected fluid. In the June 12, 2020 response,

Florence Copper proposed to install early warning ACDs on 10 percent of the ISCR wells to monitor for vertical migration of injected fluid. These early warning ACDs will be installed well below the vertical limit of the exempted aquifer and will serve to detect vertical migration of injected fluid in the areas between and beneath the proposed six additional monitoring wells at the western edge of the ISCR wellfield.

3. Cross-sections A-A', C-C', D-D', and E-E' included in the October 4, 2019 UIC Application show that the bedrock contact drops off to the west of the ISCR wellfield, creating a section of LBFU that is more than 200 feet above the bedrock contact and thus a non-exempted aquifer. Florence Copper has not proposed additional monitoring wells on the north, east, and south side of the ISCR wellfield because no section of non-exempted LBFU occurs above the ore body in those areas. The early warning ACDs described above will be installed on 10 percent of all of the ISCR wells, including those on the north, east, and south side of the ISCR wellfield, and will be used to monitor for vertical migration of injected fluid in those areas.
4. Florence Copper has proposed to conduct monitoring for vertical migration of injected fluid within the ISCR wellfield using the early warning ACDs described above, which will be installed on 10 percent of all ISCR wells. This monitoring will be conducted in addition to the monitoring of two ACDs installed at the vertical limits of the exempted aquifer on every ISCR well, perimeter well, and observation well. The density of ACD monitoring within the ISCR wellfield (two ACDs on every well, and three ACDs on 10 percent of ISCR wells) precludes the need for additional monitoring wells within the ISCR wellfield area.

Comment 5:

In the additional information dated June 12, 2020, FCI responded to the EPA comment as follows: "The resistivity values measured at the first monitoring event in September 2018 ranged from 45.88 to 77.95 ohms. Resistivity values measured at the most recent monitoring event in January 2020 ranged from 49.48 to 84.33 ohms. The resistivity values have generally increased since the initial baseline monitoring was conducted and during PTF operations." FCI further states that "none of the values have fallen below the minimum resistivity value measured prior to the commencement of PTF operations" and "[t]he change of resistivity values measured at ACDs on the two wells with a decreasing trend is less than the amount of change that would be generated from vertical migration of injected fluids."

On July 23, 2020, FCI provided ACD data from September 2018 and all ACD data collected during PTF operations. Identify the baseline resistivity values for comparison with the values measured during PTF operations and further justify the basis for the statement about the decreasing trend in two of the wells. Do the September 2018 readings represent the baseline resistance values prior to injection? Explain what decrease in resistance would indicate a Part 2 mechanical integrity failure and potential fluid migration out of the injection zone.

Response to Comment 5:

The September 2018 monitoring event was when the only pre-injection ACD resistivity values were collected prior to the commencement of injection at the PTF wellfield in December 2018. The next ACD monitoring event was conducted on December 20, 2018, five days after PTF operations had begun. The baseline ACD values for the PTF wellfield are represented by the September 2018 ACD data, and the

range of values measured during that event reflect the range of pre-operation conditions at the PTF wellfield.

It is important to note that the two wells with slight decreasing ACD resistivity trends are observation wells that do not experience pressurized injection, and consequently would not have pressure induced casing breaches or be filled with injection fluid. Because no injection occurs at these two wells, they will not experience a Part 2 mechanical integrity failure as a result of injection at the well.

It is also important to note that the PTF ACDs are installed above the MFGU, approximately 145 feet above the injection zone, and that there are four additional bulk conductivity sensors installed on the well casing below each ACD. Consequently, fluid migrating vertically from the injection zone would trigger alerts at four lower elevations prior to reaching the ACD. The bulk conductivity monitoring data collected weekly on four horizons below each ACD during PTF operations show that there has been no vertical migration of injected fluid. Consequently, no Part 2 mechanical integrity failure is indicated at these two wells.

Further, the most recent ACD resistivity values measured at the two wells with slight decreasing trends (O-04 and O-06) remain within the range of background values measured during the September 2018 monitoring event. Specifically, the initial ACD resistivity values measured at wells O-03, O-07, and WB-01 were lower than the current values measured at wells O-04 and O-06, and consequently remain within the range of observed background values.

The injected solution is highly conductive, and if the solution were to migrate vertically to the area between the electrodes the resistivity would decrease significantly. The change in contact resistance will be directly influenced by ionic fluids coming in close proximity to the sensors. At the PTF wellfield, the change in resistivity would be abrupt and sufficiently large enough (an order of magnitude or more) to distinguish it from environmental or system drift.

For the commercial ISCR wellfield, Florence Copper has proposed to the Arizona Department of Environmental Quality to conduct statistical analyses of baseline ACD resistivity data to calculate an alert level (AL) for future ACD monitoring.

Florence Copper has proposed to establish a well bore conductivity AL value for each resource block that reflects the range of variability observed in background well conductivity measurements. The AL value will be established as a Background Threshold Value (BTV) calculated using baseline well bore conductivity values measured at the wells within each resource block. The number of wells contained in each resource block varies from 3 wells in the smallest blocks to approximately 60 wells in the largest blocks. The BTV will be calculated using data from all of the wells planned for each resource block. Resource blocks that have fewer than 4 wells will use the BTV from the nearest adjacent resource block. The BTV for each resource block will be calculated using ProUCL, a software package prepared and promulgated by the USEPA.

Three background well bore conductivity measurements will be taken at each Class III well over a period of 2 weeks and beginning at least 2 weeks after the cement well seal has been emplaced. A minimum of three measurements are recommended to ensure that equipment and procedural variability do not produce an undue impact on the conductivity values measured. Because the background data collection period is

relatively short, the magnitude of potential temporal natural variation in conductivity values may not be fully characterized. To account for potential long-term temporal variations in measured conductivity values, the historical conductivity data collected from the existing monitoring wells in the previously developed resource blocks will be assessed to quantify the degree of variation from a mean conductivity value over the observation period. In the case of the first resource block to be developed, the PTF observation wells will be used to assess potential long-term variability.

Please contact me at 520-316-3710 if you require any additional information.

Sincerely,
Florence Copper Inc.

Brent Berg
General Manager

cc: Maribeth Greenslade, Arizona Department of Environmental Quality

Enclosures:
Attachment C, Well Construction/Conversion Information, Revised July 2020